

PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

To:

Commissioner
 US Department of Commerce
 United States Patent and Trademark
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 ETATS-UNIS D'AMERIQUE
 in its capacity as elected Office

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International filing date (day/month/year) 18 October 2000 (18.10.00)	Priority date (day/month/year) 18 October 1999 (18.10.99)
Applicant TUVNES, Petter et al	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
 14 May 2001 (14.05.01)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Charlotte ENGER Telephone No.: (41-22) 338.83.38
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ance Notes on Codes and Abbreviations" appearing at the begin-
ning of each regular issue of the PCT Gazette.

(54) Title: METHOD AND USE OF CALCIUM NITRATE FOR FOAMING OF STEEL-MAKING SLAGS

(57) Abstract: The invention concerns a method of foaming steel-making slags, wherein calcium nitrate is added to the slag alone or together with carbon. Calcium nitrate and carbon can be fed into the slag trough chutes or trough lances with injection gases such as air, nitrogen, carbon dioxide or inert gases. The solid components can be injected separately or with the same lance as a mixture or injected as pre-fused granules. For ladle slag foaming, calcium nitrate and carbon is added from above the melt. It is preferred to use a ratio between calcium nitrate and carbon in the range from 4:1 to 2:1. For foaming of stainless steel slag, it is preferred to add FeSi, Al or Mg before calcium nitrate and carbon is added or injected into the slag by an injection gas. Air, nitrogen, carbon dioxide or inert gases can be used as injection gas. The invention also concerns the use of calcium nitrate as a foaming agent for steel-making slags. The invention can be used for slag foaming in electric arc furnaces and ladles.

METHOD AND USE OF CALCIUM NITRATE FOR FOAMING OF STEEL-MAKING SLAGS

The invention concerns a method of foaming steel-making slags and a use of calcium nitrate as a slag foaming agent in steel-making.

The use of electric arc furnaces, converters and ladles in steelmaking are techniques well-known to those skilled in the steelmaking profession, ref. T. Abel Engh; "Principles of Metal Refining", Oxford Science Publications, ISBN 0-19-856337-X, (1992).

The electric arc process differs from other steelmaking processes in its use of scrap steel as most of the charge. The scrap is added to the furnace at the beginning of the process cycle and melted down by the passage of electric current through the furnace's graphite electrodes. Slag formers are added during melt down, in order to protect the melt from oxidation. A slag is formed on the surface of the charge during the initial melt-down, which remains during the entire process cycle until tapping of the heat. The composition of the slag layer will be dependent on the impurities in the melt and on further additions to the melt. After melting, the steel is transferred to converters and ladles.

In the latest years steel producers have made an effort in obtaining good methods for creation of foaming slags, as these give several process advantages. A foaming slag will give better insulating properties meaning less heat loss from an electric arc furnace. The refractories and electrodes are protected from arc radiation which means increased lifetime, and the sound is muffled. The electric arc is stabilised and it is possible to increase the power input, giving increased productivity. Different slag foaming methods and agents are thus described in the literature.

From US patent No. 4 528 035 it is known a method of foaming the slag generated in a steel making electric arc furnace after melt-down of steel raw material by introducing a foaming agent comprising essentially of calcium oxide (CaO) and free carbon (C) particles when the amount of said slag atop said melted steel is at least 4 inches deep.

US patent No. 4 447 265 describes a slag-foaming composition and process for use in electric arc furnace steel-making. The compositions comprise from about 15 to 80 wt % of a carbon source, the remainder consisting substantially of a source of an oxide of calcium; alternatively, the compositions comprise from about 15 to 30 wt % of a carbon source, the remainder consisting substantially of dolomite lime. The process consists of the addition, in the course of steelmaking using an electric arc furnace, of the steelmaking additive compositions of the invention to the charge subsequent to the initial scrap steel melt down.

From FR 2 634 787 it is known a method for the production of a foaming slag by blowing oxygen close to the metal-slag interface and by the addition into the slag of a carbonised material previously mixed with a carbonate material such as limestone or dolomite.

From JP08041521 it is known that foaming of a slag in a ladle can be achieved by adding lime nitrogen having C source (CaCN) from above the melt thereby causing the slag volume to increase in such a way that deslagging of the ladle is more efficient.

Stainless steel slags are difficult to foam and it has only recently been able to develop reliable methods for creating foaming slags in the arc furnace. Such a method is described in Masucci, P., Capodilupo, D., Brascugli, G. (1993), "Foaming slags for stainless steel smelting in the electric arc furnace," Electric Furnace Proceedings, pp 289-294. Limestone, CaCO_3 , and coke have been added to give foaming. Special ovules have been used to promote a closer contact between limestone and coke. These are composed of a mix of limestone and metallurgical coke (with a C content of 87 %) with grains measuring 0.5 to 1 mm and bound with starch. The ratio of graphite and limestone is 50/50. Slag foaming was achieved by blowing large quantities of oxygen and adding the limestone-coke ovules.

For current slag foaming processes for stainless steel-making, the composition range of the slag has to be very narrow in order to achieve proper foaming. Another disadvantage is that an unacceptable amount of the alloying element Cr is oxidised to Cr_2O_3 and lost

in the slag, ref. M. Görnerup, Doctoral Thesis "Studies of Slag Metallurgy in stainless Steelmaking", ISBN 91-7170-205-9 (1997).

The object of the invention is to find other efficient foaming agents and especially agents that produce foam in stainless steel slags. Another object is to avoid the disadvantages with earlier known agents.

These and other objects of the invention are obtained by the process as defined in the patent claims.

The invention thus concerns a method of foaming steel-making slags, wherein calcium nitrate is added to the slag together with carbon. Calcium nitrate and carbon can be fed into the slag, with injection gases such as air, carbon dioxide or inert gases. The solid components can be injected separately or with the same lance or injected as pre-fused granules. For ladle slag foaming calcium nitrate and carbon is added from above the melt. It is preferred to use a ratio between calcium nitrate and carbon in the range from 4:1 to 2:1. For foaming of stainless steel slag, it is preferred to add FeSi, Al or Mg before calcium nitrate and carbon is added or injected into the slag by an injection gas. Air, carbon dioxide or inert gases can be used as injection gases. The invention also concerns the use of calcium nitrate as a foaming agent for steel-making slags. The invention can be used for slag foaming in electric arc furnaces and ladles.

We have found that calcium nitrate is an efficient foaming agent for steel-making slags, especially for stainless steel.

Bubbles are formed when a gas is introduced into a slag. Bubbles on top of the foam rupture and decay. At steady state the liquid carried upwards as a thin film separating the bubbles is balanced by the downward flow of liquid released by the top rupturing process. For a given slag the height of the foam increases with the gas flow rate. If the gas flow stops, the films become thinner as they drain. Then the bubbles rupture when a critical film thickness is reached.

Foaming of low alloy steel slags

For low alloy steel-making slags, foam today is produced by two main routes that both require that carbon and oxygen react to CO:

- a) Injected oxygen in the steels reacts with iron oxide that ends up in the slag. In the following step the iron oxide is reduced by injected carbon and CO gas is formed. Carbon dissolved in the steel may also contribute to gas production.
- b) Carbon (injected in the slag or dissolved in the steel) and injected oxygen react directly to give CO.

Doubtless, other gases than CO can give foaming. Thus, calcium nitrate together with carbon at steel-making temperatures reacts as follows:



Due to the high partial pressure of oxygen and the presence of iron and CaO, a Fe_2O_3 -CaO slag is formed.

Use of calcium nitrate as an agent for producing a foaming slag in the electric arc will serve the triple objective of adding lime to increase the basicity of the slag (for removal of P and S), supplying gaseous components N_2 and H_2O to promote foaming and O_2 for the reaction with the injected carbon, giving CO which also promotes foaming. The calcium nitrate, mixed with carbon, could be added through chutes or injected by a gas or air into the slag through a lance. The calcium nitrate may be used with or without various amounts of crystal water $\text{Ca}(\text{NO}_3)_2(\text{H}_2\text{O})_x$ (where $x = 0-3$). Various small amounts of other elements may also be present, e.g. ammonium etc.

Calcium nitrate is particularly interesting in cases where nitrogen in steel is beneficial as in austenitic stainless steel, where it improves pitting resistance and strength. Also in some unalloyed/low alloyed steels, nitrogen will increase strength and hardenability.

Foaming of stainless steel slag

Normally a stainless steel contains 12-30 % Cr and other elements of which Ni and Mo are the most important. The necessity of removing carbon to low levels in the presence of chromium determines the special character of stainless steel-making.

The most common route for stainless steel-making today is to melt low alloy or stainless scrap, and ferro-alloys in an electric arc furnace. The decarburization, recovery of Cr from the top-slag by reduction, sulphur removal and adjustment of the steel composition is carried out in a converter.

For stainless steels one has only recently been able to develop reliable methods for creating a proper foaming slag in arc furnaces. The reason seems to be some subtle effects caused by the Cr_2O_3 content of the slag. The Cr_2O_3 has a low solubility in electric arc furnace slags and some of it remains as a solid second phase. This chromium oxide reacts very slowly with carbon to give CO and to recover the Cr.

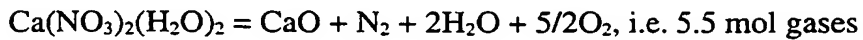
Since Cr_2O_3 is unwanted in a foaming slag, it is suggested that CO-foaming in stainless steel slag is generated involving the metal phase as little as possible. First, FeSi or Al or Mg should be added to prevent the oxidation of Cr and to reduce the Cr_2O_3 -content in the slag, and thereafter calcium nitrate and carbon should be injected carefully into the slag. The solid components are injected separately or with the same lance, or injected as pre-fused granules.

The invention will be illustrated by the following examples:

The technical grade calcium nitrate available on the market (for example Nitcal® from Norsk Hydro ASA) has a chemical composition close to $\text{Ca}(\text{NO}_3)_2(\text{NH}_4\text{NO}_3)_{0.2}(\text{H}_2\text{O})_2$ and has the form of granules with a diameter of about 2 - 4 mm. If mixed with a carbon source, this source should have the form of a powder. The mixing ratio of calcium nitrate to carbon should be in the range from 4:1 to 2:1.

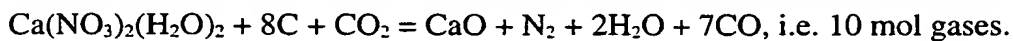
Various processes are possible:

1) Addition of calcium nitrate alone or injection by gas (inert gas, air or CO₂) that will stir the slag. Calcium nitrate will mainly decompose to CaO slag and O₂, N₂, H₂O gases:



1 kg calcium nitrate (ca. 5 mol) may give about 27.5 mol gases = 0.616 Nm³ of gases.

2) Injection of calcium nitrate + C by CO₂ will give CaO slag and N₂, H₂O, CO gases:



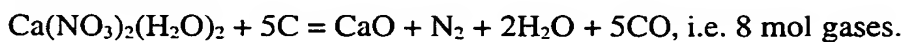
1 kg calcium nitrate + 0.48 kg C + 0.22 kg CO₂ => 50 mol gases = 1.1 Nm³ gases.

3) Injection of calcium nitrate + C by air will give CaO slag and N₂, H₂O, CO gases:



1 kg calcium nitrate + 0.54 kg C + 0.72 kg air => ca. 75 mol gases = 1.7 Nm³ gases.

4) Injection of calcium nitrate + C by nitrogen or inert gas will give CaO slag and N₂, H₂O, CO gases:



1 kg calcium nitrate + 0.3 kg C => ca. 40 mol gases = 0.9 Nm³ gases.

Ca. 0.05 kg (0.04 Nm³) nitrogen per kg calcium nitrate is necessary as injection gas.

Example

Demonstration tests have been carried out. About 1.5 kg of stainless steel type AISI 302 was melted in a crucible by a gas flame. After melting, about 0.3 kg calcium nitrate, Nitcal ®, was poured on top of the melt. The high temperature of the melt and crucible caused the calcium nitrate to melt, decompose and react by evolving gases which bubbled out of the molten calcium nitrate and created a foam. The decomposition periode took about 2 minutes after the calcium nitrate had been added, and converted the calcium nitrate to a foamy substance with about 2-3 times volume increase.

Full scale testing of Nitcal® in an EAF with the purpose to observe the behaviour and foaming potential of Nitcal® has been conducted. Up to 300 kg Nitcal® per melt (3,5 kg Nitcal/ton steel) was injected by air into the melt simultaneously with separate carbon injection. No dramatic reactions occurred despite the crystal water content in Nitcal®. The tests showed that Nitcal® is easy to handle and inject into the melt of an EAF by simple and standard injection equipment. Gas evolution and reaction with C was observed. Injection by air will give oxidising conditions that will increase the level of Cr_2O_3 in the slag. Injection of Nitcal® together with C in such a way that the oxygen in Nitcal® reacts with C to CO does not increase the NO_x level from the EAF. The result of the tests in the EAF showed that Nitcal® should be injected into the melt by nitrogen together with sufficient amount of carbon (1 kg Nitcal® requires 0,3 kg C) in order to achieve reducing conditions and reduced loss of Cr to the slag.

The total foam hight that is wanted, may be achieved by adding various amounts of calcium nitrate. Compared to current practice, about 10 kg of calcium nitrate per ton steel charge must be added in order to achieve the same amount of gas evolution as typical for current practices.

Patent claims

1. Method of foaming steel-making slags, wherein calcium nitrate is added to the slag alone or together with carbon.
 2. Method according to claim 1, wherein calcium nitrate alone or mixed with carbon is injected into the slag with injection gases such as air, nitrogen, carbon dioxide or inert gases.
 3. Method according to claim 2, wherein the solid components are injected separately or with the same lance or injected as pre-fused granules.
 4. Method according to claim 1, wherein calcium nitrate alone or mixed with carbon is added from above the melt.
 5. Method according to claim 1 -4, wherein the ratio between calcium nitrate and carbon is in the range from 4:1 to 2:1.
 6. Method of foaming of stainless steel slag, wherein FeSi, Al or Mg is added before calcium nitrate and carbon is added or injected into the slag by an injection gas.
-
7. Method according to claim 6, wherein air, nitrogen, carbon dioxide or inert gases are used as injection gases.
 8. Use of calcium nitrate as a foaming agent for steel-making slags.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 00/00345

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: C21C 5/52, C21C 5/54

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: C21C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	FR 2634787 A1 (INSTITUT DE RECHERCHE DE LA SIDE-RURGIE FRANCAISE, IRSID.), 2 February 1990 (02.02.90)	1-8
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A	JP 8041521 A (NIPPON STEEL CORP) 1996-02-13 (abstract) World Patents Index (online). London, U.K.: Derwent Publications, Ltd. (retrieved on 2001-03-05). Retrieved from: EPO WPI Database, DW199616, Accession No. 1996-157404; & JP 8041521 A (NIPPON STEEL CORP) 1996-06-28 (abstract) (online) (retrieved on 2001-03-05). Retrieved from: EPO PAJ Database.	1-8
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A	EP 0829545 A1 (USINOR SACILOR SOCIETE ANONYME), 18-March-1998-(18-03-98)	1-8
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☒ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search

Date of mailing of the international search report

5 March 2001

07-03-2001

Name and mailing address of the ISA/

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PCT/NO 00/00345

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Form PCT/ISA:210 (continuation of second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT
Information on patent family members

05/02/01

International application No.
PCT/NO 00/00345

Patent document cited in search report			Publication date	Patent family member(s)	Publication date
FR	2634787	A1	02/02/90	NONE	
EP	0829545	A1	18/03/98	AU 719924 B	18/05/00
				AU 3424797 A	19/03/98
				BR 9704689 A	29/12/98
				CA 2210505 A	12/03/98
				CN 1180751 A	06/05/98
				FR 2753205 A,B	13/03/98
				JP 10088223 A	07/04/98
US	5395420	A	07/03/95	AT 169964 T	15/09/98
				DE 69320482 D	00/00/00
				EP 0655508 A,B	31/05/95

INTERNATIONAL SEARCH REPORT

International application No.

PCT/NO 00/00345

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: C21C 5/52, C21C 5/54

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: C21C

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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A	FR 2634787 A1 (INSTITUT DE RECHERCHE DE LA SIDE-RURGIE FRANCAISE, IRSID.), 2 February 1990 (02.02.90) --	1-8
A	JP 8041521 A (NIPPON STEEL CORP) 1996-02-13 (abstract) World Patents Index (online). London, U.K.: Derwent Publications, Ltd. (retrieved on 2001-03-05). Retrieved from: EPO WPI Database, DW199616, Accession No. 1996-157404; & JP 8041521 A (NIPPON STEEL CORP) 1996-06-28 (abstract) (online) (retrieved on 2001-03-05). Retrieved from: EPO PAJ Database. --	1-8
A	EP 0829545 A1 (USINOR SACILOR SOCIETE ANONYME), 18 March 1998 (18.03.98) --	1-8

☒ Further documents are listed in the continuation of Box C.
 ☒ See patent family annex.

<ul style="list-style-type: none"> * Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed 	<ul style="list-style-type: none"> "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family
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Date of the actual completion of the international search	Date of mailing of the international search report
5 March 2001	07 -03- 2001
Name and mailing address of the ISA: Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Anna-Maj Magnusson/MP Telephone No. +46 8 782 25 00

International application No.

PCT/NO 00/00345

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Form PCT/ISA.210 (continuation of second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT
Information on patent family members

05/02/01

International application No.

PCT/NO 00/00345

Patent document cited in search report			Publication date	Patent family member(s)	Publication date
FR	2634787	A1	02/02/90	NONE	
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EP	0829545	A1	18/03/98	AU 719924 B	18/05/00
				AU 3424797 A	19/03/98
				BR 9704689 A	29/12/98
				CA 2210505 A	12/03/98
				CN 1180751 A	06/05/98
				FR 2753205 A,B	13/03/98
				JP 10088223 A	07/04/98
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US	5395420	A	07/03/95	AT 169964 T	15/09/98
				DE 69320482 D	00/00/00
				EP 0655508 A,B	31/05/95
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PATENT COOPERATION TREATY

PCT

REC'D 22 AUG 2001	
WIPO	PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P9978		FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)	
International application No. PCT/NO00/00345	International filing date (day/month/year) 18/10/2000	Priority date (day/month/year) 18/10/1999	
International Patent Classification (IPC) or national classification and IPC C21C5/52			
Applicant NORSK HYDRO ASA et al.			



1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2. This REPORT consists of a total of 4 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

 These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 14/05/2001	Date of completion of this report 20.08.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Noske, W Telephone No. +49 89 2399 8448 

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/NO00/00345

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-7 as originally filed

Claims, No.:

1-8 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
 - ☐ the language of publication of the international application (under Rule 48.3(b)).
 - ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).
3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:
- ☐ contained in the international application in written form.
 - ☐ filed together with the international application in computer readable form.
 - ☐ furnished subsequently to this Authority in written form.
 - ☐ furnished subsequently to this Authority in computer readable form.
-
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
 - ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/NO00/00345

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims 1-8
	No: Claims
Inventive step (IS)	Yes: Claims 1-8
	No: Claims
Industrial applicability (IA)	Yes: Claims 1-8
	No: Claims

2. Citations and explanations
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/NO00/00345

The claimed subject-matter differs from nearest prior art,
D1 JP-A-8 041521, addition of lime nitrogen comprising C,
as mentioned in the application, p. 2,
in the addition of calcium **nitrate** or in the use of this additive to the slag.
Such an addition is effective for foaming the slag and there is no pointer to the addition
in the prior art documents.

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference P9978	FOR FURTHER ACTION		See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/NO00/00345	International filing date (<i>day/month/year</i>) 18/10/2000	Priority date (<i>day/month/year</i>) 18/10/1999	
International Patent Classification (IPC) or national classification and IPC C21C5/52			
Applicant NORSK HYDRO ASA et al.			

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.


2. This REPORT consists of a total of 4 sheets, including this cover sheet.

☐ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☐ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☐ Certain defects in the international application
- VIII ☐ Certain observations on the international application

Date of submission of the demand 14/05/2001	Date of completion of this report 20.08.2001
Name and mailing address of the international preliminary examining authority:  European Patent Office D-80298 Munich Tel. +49 89 2399 - 0 Tx: 523656 epmu d Fax: +49 89 2399 - 4465	Authorized officer Noske, W Telephone No. +49 89 2399 8448



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/NO00/00345

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, pages:

1-7 as originally filed

Claims, No.:

1-8 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/NO00/00345

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-8
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-8
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-8
	No:	Claims	

2. Citations and explanations
see separate sheet

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/NO00/00345

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in the prior art documents.